Advantages of Fiber interspaced compared to Aluminum interspaced grids.

Statement
The ultimate challenge for the optimal grid design is: “Where to put the lead without seeing it.”
Or in different words:
The optimal grid is as much as possible transparent for primary radiation and absorbs scattered radiation as much as possible.

Intermezzo
The function of a grid has been shifted from basic contrast enhancement (called contrast improvement factor K) to signal to noise improvement because of the introduction of digital detectors.
Contrast deterioration caused by scatter can be compensated (although limited) by electronic image processing in a digital detector based system. But also the quantum noise of scattered radiation will be amplified resulting in a poor overall signal to noise performance of the system.
A better way to describe grid characteristics in a digital detector environment is to define a signal to noise improvement factor or Q-factor.

$$Q = \frac{t_p^2}{t_t}$$ t_p = primary transmission. t_t = total transmission

When optimizing a grid for scatter absorption the trade-off between reduction of primary transmission and total transmission must be carefully made. Low X-ray absorbing of interspace material (high t_p) is is pre-requisite for the best signal to noise improvement.

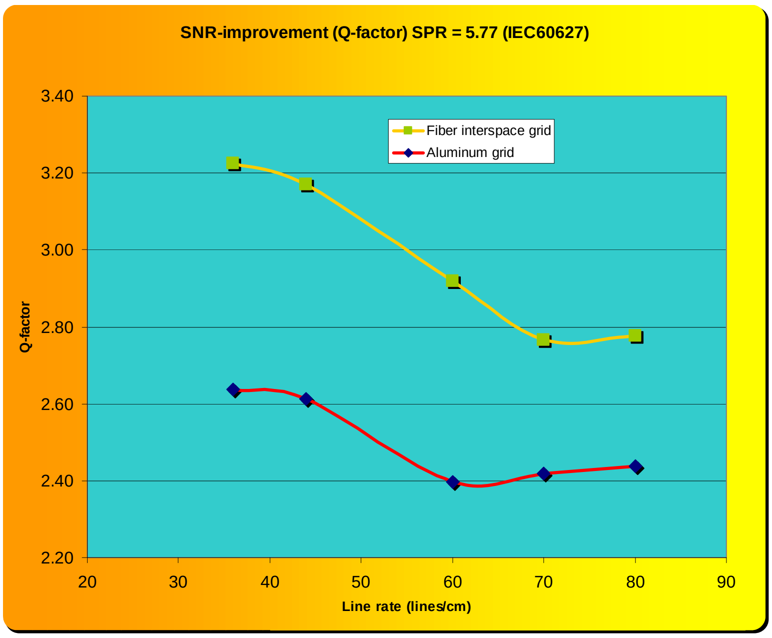
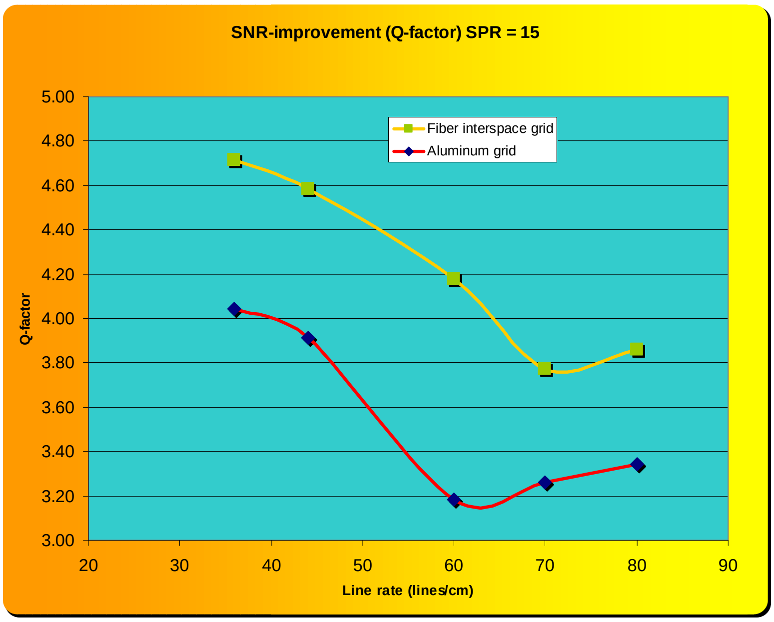


Figure 1 Fiber interspace vs Al at SPR 5.77

In the following figures (1 and 2) graphs the grid performance of different grid types (Fiber interspaced and Aluminum interspaced, ratio 13, except for 80line=ratio 15) at different scatter to primary ratios has been given. The reason for the difference in scatter to primary ratio is that with the increased field of view size (43x43cm) and more obese patients the amount of scatter also increases. Studies at the Mayo Clinic in cooperation with Smit Röntgen have shown that the scatter to primary ratio (further called SPR) can easily exceed a factor 15 (40cm patient) up to 23 (50cm patient) compared to the “classical” IEC value of 5.7.

Figure 1 visualizes the Q-factor difference between fiber and .luminum at a SPR of 5.77. For a 60line grid the fiber Q-factor improves by 23% compared to aluminum.



In figure 2 the same grids are compared at a SPR of 15. This represents conditions for more obese patients (40cm thickness) and a field of view of 43x43cm.
In this situation the Q-factor advantage of fiber interspace grids increases up to 31% resulting in an equal SNR improvement.

Figure 2 Fiber interspace vs Al at SPR 15

In both graphs it is also visible that at increasing line rate the efficiency of the grids decreases. This is the result of a less than optimal ratio of required lead content, line rate and grid ratio to enable an adequate application range.
The design of Smit Röntgen grids has been optimized for maximum performance taken the previous mentioned requirements into account.

Conclusion:
To achieve optimal signal to noise improvement grid parameters must be carefully chosen. Improving the transmission of primary radiation and sustaining the absorption of scattered radiation **always** results in improved signal to noise performance and thus better image quality. Fiber interspaced deliver an SNR gain of at least 20%, increasing to more than 30% compared to aluminum interspaced grid.